IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Examiner: Horton, Yvonne Michele

Alfred D. COMMINS, et al. Art Unit: 3635

Serial No.: 10/705,662 Confirmation No.: 6146

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Title: DIAPHRAGM WITH PERIMETER EDGING ON STRUCTURAL PANELS

DECLARATION OF STEVEN PRYOR
PURSUANT TO 37 C.F.R. §1.132

I, STEVEN PRYOR, declare that:

1. I am currently the Building Systems Research and Development Manager for Simpson Strong-Tie Company, Inc. ("Simpson"), the assignee of the above-entitled patent application. In 1990, I received a B.S. in Civil Engineering, with Structural Engineering emphasis, *magna cum laude*, from Rose-Hulman Institute of Technology, Terre Haute, Indiana. I am a member of the American Society of Civil Engineers, Structural Engineers Association of Northern California, Building Seismic Safety Council, and Earthquake Engineering Research Institute. I am a registered Civil Engineer, California, #C50670, 1993, and Structural Engineer, California, #S4104, 1997.

2. While at Simpson, I have held a number of positions. I have been in my current position since 2003. My responsibilities include developing and managing Simpson's Tyrell Gilb Research Laboratory, and implementing the use of advanced nonlinear finite element analysis tools as standard operating procedure in the development of new products and test equipment. I have been a member of the Building Seismic Safety Council's Technical Subcommittee 7, Wood Construction, and I authored and presented a paper, The Effect of Eccentric Overturning Restraint in Complete Shear Wall Assemblies, at the 2003 Pacific Conference on Earthquake Engineering, Christchurch, New Zealand.

3. From 1998 to 2003, I held the position of Lateral Force Resisting Systems Manager at Simpson, and, among other things, I was responsible for research and development efforts of the Strong-Wall product line. The Strong-Wall product line includes products built in accordance with the disclosure of above-entitled patent application. In this capacity, I managed shake table testing of these products, and I authored and presented a paper, Seismic Testing and Analysis Program on High Aspect Ratio Wood Shear Walls, at the 2000 World Conference on Timber Engineering, Whistler, Canada. I have also worked with outside vendors to develop custom nonlinear dynamic response history analysis software that predicts the earthquake response of shear walls by using full scale test data from cyclic testing to calibrate phenomenological models.

4. From 1997 to 1998, I was the Plated Truss Project Manager at Simpson. In this capacity, I developed several new products, including the Simpson's DSC, THGW, LTHJA26 and THJA26 truss hangers for wood-to-wood connections, and represented Simpson on truss industry technical committees.

5. Prior to my work at Simpson, I worked as a Project Engineer from 1994 to 1997 at Gang-Nail Truss Company, in Visalia, California. In this capacity, I performed structural design of new and existing residential, commercial and industrial structures using concrete, masonry, heavy timber, light-framed wood and steel, and heavy structural steel. During this time, I used numerical simulations in both structural engineering design and plated truss development, utilizing STAADS and Stardyne finite element codes. Prior to my work at Gang-Nail Truss, from 1990 to 1994, I worked as a Project Engineer at Butler Manufacturing Co., in Visalia, California. While at Butler, I performed structural design of new commercial and industrial structures using both light-gauge and heavy structural steel.

6. I have reviewed the above-identified patent application, including the specification, drawings and claims. I have also reviewed U. S. Patent No. 5,706,626 issued to Mueller ("Mueller"), U.S. Patent No. 5,390,466 issued to Johnson ("Johnson"), and U.S. Patent No. 4,037,381 issued to Charles ("Charles"). I have also reviewed the office action dated June 17, 2005, and

understand that the Mueller, Charles and Johnson patents have been cited as prior art against this patent application.

7. I have also reviewed photographs and documentation related to cyclic testing of the Mueller wall, copies of which are attached hereto as Exhibits 1 and 2. It is my understanding that on September 27, 1999, Lee Mueller, the inventor and owner of the Mueller Patent, assigned the patent to Simpson. It is also my understanding that, at Simpson's request pursuant to the terms of the assignment contract, Mr. Mueller provided Simpson with the photographs and documentation contained in Exhibits 1 and 2. These documents show that cyclic testing of the Mueller walls was conducted on two different days -- October 28, 1995 (Exhibit 1) and November 12, 1995 (Exhibit 2). Based on my review of the documentation, I believe that slightly different variations of the Mueller wall were tested on the two days, as discussed in more detail below.

8. I am familiar with a number of metal and wood wall designs, the performance of metal and wood walls under shear loading, and the design issues involved with prefabricated metal and wood walls. I have personally conducted or witnessed hundreds, if not thousands, of cyclic load tests of metal and wood structural panel walls.

9. Steel panel walls perform differently than wood panel walls. The desired failure mechanism in an all-metal structural panel wall made with the sheet steel panels joined to vertical steel side posts is different from the desired failure

mechanism in a wood structural panel wall made with wooden panels attached to vertical wooden side posts. The design considerations for such walls are also very different.

10. When a wood structural panel wall is loaded with lateral force, as a result of the nature and properties of the wooden panel, the solid wood posts and the nails connecting the panels to the posts, some non-linear yielding behavior is present, almost from the point of the initial loading. This non-linear yielding behavior becomes more pronounced as the loading on the wall is increased and the lateral deflection of the wall becomes greater. This non-linear yielding behavior is due in part to crushing of the wooden panel and wood post around the nails and is also due in part to the bending of the nails. As the wooden panel tries to slip past the wooden post, and the nail connection tries to resist this movement, the wood around the nail crushes and a portion of the nail bends in both the wooden post and in the wooden panel. Movement between the wooden panel and the wooden posts in a wood structural panel wall is greatest at the corners of the panels.

11. In a wood structural panel wall, the bulk of all the non-linear yielding behavior is the expected deformation of the nails and the wooden material of the panels and posts around the fasteners. It is my belief that a certain amount of such non-linear yielding behavior in a wood structural panel wall is desirable as these crushing and deformation actions dissipate the lateral forces imposed on the wood wall.

12. In contrast, a steel structural panel wall performs differently when the wall is loaded with lateral force. Steel has a material stress-deformation relationship that is very predictable, elastic and linear up to the yield point of the steel. As a result of the nature and properties of the metal components that comprise a steel structural panel wall, there is very little, if any, non-linear yielding behavior present during the initial loading of the wall with lateral stress. An all-metal structural panel wall demonstrates nonlinear yielding behavior only when the applied force creates stresses in the wall in excess of the material yield strength. This is typically observed when the loading on the wall is increased and continues to the point of failure.

13. I understand the Mueller wall to be a prefabricated structural panel wall made entirely of metal. The Mueller patent describes the inner retaining members 114, the reinforcing members 116, the diaphragm members 110 and the outer retaining members 120 as being formed of 18 gauge steel. These members are joined by screws 124 that run almost the entire length of the inner retaining members, the diaphragms and the outer retaining members. The Mueller wall also includes reinforcing members 140 that interconnect the vertical side posts and appear to be connected by screws to the diaphragms 110. The patent discloses that these reinforcing members 140 serve the purpose of reducing the tendency of the diaphragms 110 to buckle under loads generated by shear forces.

14. Similarly, as evidenced by the documents attached hereto as Exhibit 1, four embodiments of the Mueller structural panel wall that were tested on October 28, 1995 were made entirely of metal. Like the structural panel wall described in the Mueller patent, it appears that some of the walls tested on October 28 had u-shaped inner retaining members, sheet steel panel diaphragms and u-shaped outer retaining members. In one test conducted on October 28 -- test 1500 -- all of these members were made from 18 gauge steel. As in the Mueller patent, these members were connected almost entirely along their lengths with screws. The photographs of the embodiments of the Mueller wall tested on October 28 appear to show the reinforcing members 140 that interconnect the vertical side posts and that are connected to the sheet steel diaphragms, although the Exhibit 1 drawings do not show these reinforcing members.

15. Referring to Exhibit 2, all four of the embodiments of the Mueller wall tested on November 12, 1995, were also made entirely of metal. Like the structural panel wall described in the Mueller patent, it appears that some of the walls tested on November 12 had u-shaped inner retaining members, sheet steel panel diaphragms, and u-shaped outer retaining members. The sheet steel panel diaphragms tested on November 12 appear to be made with lips at one side in a fashion similar to the description in the Mueller patent. In tests 1200 and 1015 conducted on November 20, 2005, all of these components were made of 18 gauge steel, and were connected by screws running almost their entire length. The embodiments of the Mueller wall tested on November 12 appear to include

reinforcing members 140 that interconnect the vertical side posts and are connected to the sheet steel panel diaphragms. These members appear in the Exhibit 2 drawings, although some of the drawings (and, in particular, the exploded perspective drawing dated 11/07/95) appear to be inaccurate in their placement of these reinforcing members.

16. In a metal structural panel wall, shear forces on the wall which are strong enough to cause yielding to the point of failure may effect the screws between the panels and frame in a number of different ways, none of which involve bending of the screws. My analysis can be summarized by categorizing such failures into three alternative failure modes: (i) in the first alternative, when a sheet steel panel moves with respect to a steel vertical side post, the metal in the panel or the post distorts, rather than distorting the metal in the screw, such that the screw will rotate as a rigid body (i.e., the shaft of the screw is not distorted) on a pivot point at or near the interface of the sheet steel panel and the steel vertical side post; (ii) in a second alternative, if the material of the panel and the vertical side post are so strong or thick that they cannot be distorted, then the failure will occur at the screw, but the expected failure of the screw will be to snap under the shear force, not merely to bend or deform; and (iii) in a third alternative, if the material of either one of the panel or the side post (but not both) is so strong or thick so as to prevent the screw from pivoting at or near the interface of the two members, such that the screw is held straight out of one of the elements, and the screw is stronger than the other element, then the screw is

expected to open the hole further in the weaker of the elements through the which screw is placed.

17. The Mueller patent suggests that buckling of the diaphragms is a possible failure mode. Based on my review of the enclosed photographs and related documentation of the testing of the Mueller walls on October 28, 1995, and on November 12, 1995, I believe that the walls failed due to buckling of the sheet steel panels and the side posts and that none of the screws joining the sheet steel panels to the side posts were bent or broken. This is consistent with what I would expect, in that a designer would know to use screws of sufficient strength to avoid the second alternative with respect to failure described above. If a designer engineered the connection between the sheet steel panels and the posts to break the screws (second alternative) rather than allow for pivoting of the screws (first alternative) or the tearing of the weaker of the panels or the posts (third alternative), they would be designing the connection at the screw to at some point fail suddenly and with no warning, a poor choice in structural design of structures meant to protect human life and property.. A skilled designer would prefer to either allow some pivoting of the screw through deformation of the posts and the panels (first alternative) or some tearing of the panels or tearing of the posts (second alternative). This approach postpones the failure of the panel and allows other elements of the structure to begin to participate in resisting the load, a process known as load sharing.

18. For these reasons, a skilled professional would build the Mueller wall by using fasteners of sufficient size and strength to avoid the second alternative with respect to failure discussed above. A skilled designer would not try to prevent rotation or pivoting of the screws connecting the panels to the posts in the Mueller wall. In general, unlike wood structural panel walls, the point of failure for steel structural panel walls is not the fasteners, and the reaction of the fasteners in such steel walls is distinct from wood walls. Bending of the fasteners that connect the panels to the vertical side posts of the Mueller patent is not an issue I would consider or try to address if I were asked to improve the connection between the panels and vertical side posts of the Mueller pre-assembled internal shear panel.

19. In my opinion, adding washers under the screws 124 that connect the panels to the side posts of the Mueller wall would not have any effect on how the Mueller wall fails at ultimate load, since the observed ultimate failure of the Mueller wall is caused by the buckling of the panels and the side posts. If such an addition of washers under the screws 124 were to have any effect at all on the screws, it would be to prevent rotation or pivoting of the screws which would either make the screws more likely to break or tear the panel or side post if the lateral forces at the screws became too great. In my opinion, if the Charles brackets or the Johnson washers were added to the screws 124 of the Mueller wall, I would not expect the overall performance of the wall to improve, nor would I expect that such washers or brackets would reduce the bending of the screws connecting the

panel to the side posts. In my opinion, a designer who studied the patent references cited as prior art would not choose to combine the Charles brackets or the Johnson washers with the Mueller wall.

20. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: Dez. 18, 2005 By: _____
Steven Pryor